

***Cardiac Rehabilitation:  
Does it Add Years to Life,  
or Life to Years?***

An Honors Thesis (HONRS 499)

by

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## **Cardiac Rehabilitation: Does it Add Years to Life, or Life to Years?**

Cardiac rehabilitation settings have gained increased focus in the health care community due to the controversy over the physiological benefits of cardiac rehabilitation in patients diagnosed with coronary artery disease. A disease that is incurable and largely misunderstood, cardiovascular diseases claim a life about every 34 seconds; half of these in individuals whom have never been diagnosed with the disease (Gunby, 449). The 1993 *Facts and Statistics* booklets published by the American Heart Association estimated that 1.5 million Americans would suffer from a heart attack in 1993, killing about 500,000 of the victims (Gunby, 449).

Past research has shown that controlling the major risk factors for this deadly disease reduces the chance of developing cardiovascular disease. Three recent meta-analyses indicate a 20 to 25 percent decrease in mortality due to the risk factor modification resulting from cardiac rehabilitation (Goble, Worcester, 98). The irony of the problem is most are controllable through simple lifestyle changes. However, controlling these risk factors, which include smoking, hypertension, elevated serum cholesterol, obesity, diabetes, stress and physical inactivity, does not guarantee that one will not develop heart disease.

In a study of patients who began rehabilitation eight weeks after a heart attack, there was a higher rate of non-fatal reinfarction over a 12 month period; however, after 3 years, the overall mortality rate was significantly lower than in those who had not begun rehabilitation (Oldridge, 60). These results show that risk factor modification does not stop the disease process, but did increase the length of lives in many of the participants. Though there was a lower mortality rate after several years of rehabilitation, the more important benefit from rehabilitation is the quality of life during those extra years of life. Improved health resulting from modifying risk factors

allows people to have a better quality of life, which means a better capacity to perform daily tasks with less fatigue and chronic problems.

In effort to improve quality of life and control the multiple risk factors associated with coronary heart disease, physicians refer their patients to cardiac rehabilitation settings. The benefits gained from cardiac rehabilitation is questioned by experts, however, due in part to the failure of the patients to comply with the lifestyle modifications and to understand the education they receive about their disease process. Moderate exercise three times a week or more has been shown to reduce the risk of death 21% lower than those who exercised fewer than three times per week (Radtke, 186).

Behavior change is a difficult, life-long process, causing many to become uncompliant in their rehabilitation process. In a follow-up study at the Austin Hospital Cardiac Rehabilitation Programme, researchers found that 15 percent of the smokers had resumed smoking after four months and 39 percent after one year (Goble, Worcester, 98). As time passes, continuing the healthier habits becomes increasingly difficult for many people, creating an easier route to noncompliance. And, for some who are able to adhere to the program, risk factor modification is not enough to prevent coronary events from occurring, as indicated by the increased incidence of heart attacks in those who participate in cardiac rehabilitation.

This then raises questions about the benefits one can receive from rehabilitation: Can cardiac rehabilitation lengthen one's life by controlling the risk factors which increase the chance of coronary events? Or does cardiac rehabilitation only increase the quality of one's life by providing a foundation for healthier lifestyle?

The focus of this thesis will be three-fold. First, the risk factors will briefly be examined

individually to show the role each play in contributing to CAD. The second section will center on the benefits gained from participation in regular exercise, including the impact of activity on the risk factors for cardiovascular disease. Finally, patient compliance issues will be examined to determine the motivation for patients to continue in the rehabilitation process.

### **Risk Factors: What Are They? How Do They Affect Heart Disease?**

Past studies have shown that there are certain inherited characteristics or behavioral patterns which increase the chance of developing coronary heart disease. These characteristics or behavioral patterns, called risk factors, if controlled, have been shown to improve chances of preventing heart disease. The difficulty in understanding heart disease is that controlling the risk factors does not necessarily reduce the risk of the disease; however, studies have shown that, in many cases, risk can be decreased through risk factor modification.

In order to be classified as such, cardiovascular risk factors must meet the established criteria. These criteria, according to the Yale University School of Medicine Heart Book, include:

- 1.) There must be a strong statistical correlation between the factor and coronary artery disease, which is generally accepted as at least double the risk (Zaret, Moser, Cohen, 25).
- 2.) The association should be consistent, regardless of age, gender or race, and be reproduced in most, if not all, of the studies assessing the correlation (Zaret, Moser, Cohen, 25).
- 3.) The influence of the risk factor should be able to be produced through laboratory experiments (Zaret, Moser, Cohen, 25).
- 4.) Favorably changing the risk factors should reduce the incidence of coronary

heart disease, though several of the risk factors fail to demonstrate this relationship (Zaret, Moser, Cohen, 25).

- 5.) The risk factor, independent of all other factors, must increase the risk of developing cardiovascular disease (Zaret, Moser, Cohen, 25).

Risk factors are often divided into one of two categories: uncontrollable and alterable. Uncontrollable risk factors, which cannot be modified through behavioral changes, include *gender*, and *age*, and *family history*, which includes race. Controllable risk factors are those factors which can be managed through behavior modification. These risk factors include *hypertension*, *high serum cholesterol levels*, *smoking*, *obesity*, *diabetes*, and *physical inactivity*. *Stress* is also considered to be an controllable contributing risk factor.

Cardiovascular risk factors are also organized according to their presence within an individual. *Dichotomous factors*, such as family history and gender, are absolute factors--they are either present or absent in a person (Zaret, Moser, Cohen, 25). Most risk factors are present on a continuum, or *continuous factors*; once these risk factors reach the threshold level, any increase in number or severity of the risk factors heighten the risk of developing heart disease (Zaret, Moser, Cohen, 25).

Risk factors generally do not act alone in causing heart disease; the mixture of various factors and conditions, as well as the severity of each risk factor, is much more likely to aid in the development of artery disease. This compounding impact of risk factors on heart disease is known as an additive, or possibly a multiplicative, effect (Zaret, Moser, Cohen, 25). This effect is demonstrated in a 1977 study of longshoremen; researchers found that a combination of low-energy output, heavy smoking, and high blood pressure increased risk of a fatal heart attack by as much as 20 times (Pollock & Wilmore, 29).

Cardiovascular disease, as the leading killer of Americans, is a very devastating disease. With so many people affected by heart disease, risk factor modification has become a crucial component of the treatment process. In order to fully comprehend the impact risk factor modification can have in the prevention of coronary artery disease, society must understand the impact the risk factors, when uncontrolled, have on the cardiovascular system. This section will focus on the risk factors individually.

### *Age*

Age is an irreversible contributor to cardiovascular disease. As the years of life take their toll on the body, the risk for heart disease increases. Though the aging process cannot be stopped, its effect on the body can be minimized by healthy behaviors that reduce the risk for all types of diseases, including cardiovascular disease.

Age increases risk for coronary artery disease in many ways. Older individuals tend to be less active, and overweight. They also tend to develop hypertension, partially due to the stiffening of the arteries (Ferrini & Ferrini, 121). As a result of the long-term hypertension, the heart enlarges to pump blood through the narrowed, rigid vessels, increasing the risk for congestive heart failure (Ferrini & Ferrini, 122). The role of hypertension, inactivity, and obesity in contributing to heart disease are examined in the following sections.

### *Gender*

Men have a substantially higher risk to develop heart disease at an early age than women.

The difference between the sexes appears to be the role of estrogen in protecting women against cardiovascular disease. Estrogen increases the level of high-density lipoprotein cholesterol in women (Zaret, Moser, Cohen, 32). High-density lipoprotein helps to prevent cholesterol build-up on the walls of the arteries. The function of high-density lipoprotein in protecting against heart disease will be examined further in the cholesterol segment.

However, the risk for women upon reaching menopause, when estrogen-production discontinues, increases until it equals the risk in men (Ferrini & Ferrini, 123). This convergence of risk is gradual as the risk differential between the sexes does not intersect until about age 100 (Millard, "Women and Heart Disease," 71). The increased risk for women is due to an increased level of low-density lipoprotein, as the level of high-density lipoprotein remains constant. (Millard, "Women and Heart Disease," 72).

Post-menopausal women can continue protection against heart disease by utilizing estrogen-replacement, in combination with progesterone, without increasing the risk for uterine cancer (Zaret, Moser, Cohen, 32). Estrogen supplementation has about a 40 to 50 percent reduction in risk for cardiovascular disease (Millard, "Women and Heart Disease," 72). Interestingly, men do not benefit from the estrogen therapy. Men treated with female hormones actually had an increased risk for heart disease (Pollock & Wilmore, 21).

The higher incidence of heart disease in men has also been historically influenced. In the past, males have much higher prevalence of smoking than do females. Until the past several decades, females generally did not smoke due to the social unacceptance of female smokers. As smoking presents a strong risk for heart disease, the gender differences in risk can be further explained through the presence of smoking. In recent years, more and more women have begun

smoking, while the number of male smokers has decreased. Results in future studies may find less of a difference between the genders since smoking has become prevalent among both men and women.

Also of historical significance is past studies have been performed with only male subjects. Researchers have assumed that the risk for men can be used to apply towards women. However, this is not necessarily true due to the differences in the male and female bodies, as is true with the risk-reducing estrogen production in women.

### *Heredity*

Heredity is a proven risk factor for coronary artery disease. The precise role of family history in increasing the risk for heart disease is not known because of the virtual impossibility of separating genetic components from environmental influences. Since the family shares common experiences, such as eating habits and environmental stressors, it is difficult to determine whether heart disease is caused by the inherited behavior patterns or genetic tendencies (Pollock & Wilmore, 21).

It is also questioned whether or not family history independently contributes to heart disease. Researchers are attempting to conclude if the increased risk for disease can be caused by family history of heart disease independent of other factors, or if the risk comes from the combination of other factors which are genetically influenced (Pollock & Wilmore, 21).

Generally speaking, individuals with a family history which occurred at an early age should be especially conscientious about controlling other risk factors to reduce their risk for heart disease (Zaret, Moser, Cohen, 28). It is believed that early onset of coronary artery disease



suggests strong genetic tendencies towards the disease, and is, therefore, less controllable through behavior changes.

Included in heredity is race. Afro-Americans have an increased risk for heart disease. Though not fully understood, the Afro-American population are at higher risk for hypertension and diabetes (Zaret, Moser, Cohen, 29). The role of these risk factors in contributing to cardiovascular disease will be explored in the succeeding pages.

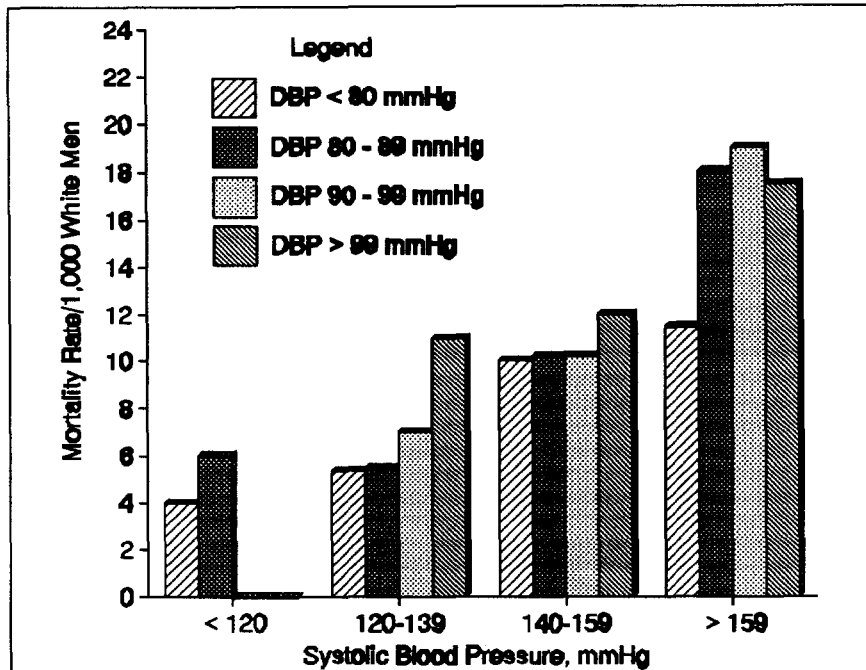
### *Hypertension*

Of the known risk factors for cardiovascular disease, hypertension, or high blood pressure, is the best understood in terms of its contributions to heart disease. Even so, hypertension affects the greatest number of Americans, with estimates ranging anywhere from 35 million to 60 million Americans (Zaret, Moser, Cohen, 29). As a powerful predictor for heart disease, elevation of blood pressure directly correlates with risk for cardiovascular disease. People with uncontrolled high blood pressure are at 3 to 4 times the risk of coronary heart disease as are those with normal blood pressure ("Healthy People 2000", 71). Figure 1 on the following page demonstrates the increased risk for hypertensive patients.

Many, however, remain untreated, often due to the assumption by the physician that the patient has "white coat hypertension." "White coat hypertension" occurs in individuals who typically have normal blood pressure, but have an elevated blood pressure reading due to the stress of being in a doctor's office (Zaret, Moser, Cohen, 153). The problem with diagnosing hypertension is that in order to obtain an accurate sense of how the patient's blood pressure responds to the stresses of everyday life, measurements should be taking over a period of several

weeks, and under various circumstances (Millard, "Nuts and Bolts..." 36). Many patients are incapable of or unwilling to have their blood pressures taken regularly, which further complicates

diagnosis.



**Figure 1** Increased risk for coronary artery disease with increased levels of blood pressure. DBP = diastolic blood pressure. (Pollock and Wilmore, 16)

Hypertension is classified in one of two categories: *primary* (essential) or *secondary* (nonessential). Primary hypertension is believed to be caused by hormonal factors relating with the manner in which the

kidneys handle salt intake

and/or the occurrence of certain circumstances which cause vasoconstriction; it is thought that primary hypertension is genetically determined, but is influenced by high-salt, low-potassium diet, and chronic stress (Zaret, Moser, Cohen, 155). Secondary hypertension is a result of other disorders, such as kidney disorders, renovascular hypertension, and adrenal tumors (Zaret, Moser, Cohen, 155). Primary hypertension, the type of high blood pressure important in the risk for heart disease, will be the core of this section.

Hypertension increases the risk of cardiovascular disease by promoting the process of atherosclerosis. Hypertension creates an increased pressure on the arterial walls. The pressure damages the artery walls, leaving them vulnerable for plaque build up (Zaret, Moser, Cohen,

157). This increases the risk for artery disease for a couple of reasons: the heart must work harder to pump blood through smaller openings caused by plaque build-up; there is a higher chance of the plaque or a blood clot occluding the artery (Zaret, Moser, Cohen, 157-158). The occluded artery prevents oxygen supplying to the heart, causing a myocardial infarction.

The tendency to develop primary hypertension is more common in some individuals than others. As a person ages, they are more likely to suffer from hypertension, due to the stiffening of the arteries (Ferrini & Ferrini, 121). Afro-Americans have a higher incidence, and severity, of hypertension than do other races ("Healthy People 2000", 71). Those with a family history of hypertension are prone to suffer from high blood pressure, suggesting a genetic tendency; diabetics tend to have high blood pressure due to increased insulin levels in the blood; people who are overweight are also inclined to have hypertension (Zaret, Moser, and Cohen, 31, 157).

Since hypertension is the best understood risk factor for heart disease, the treatment for elevated blood pressure has been very effective. According to Dr. Robert S. Eliot, chairman and director at the Institute of Stress Medicine in Denver, and clinical professor of Cardiology at the University of Nebraska College of Medicine, hypertension is the worst-managed of the major risk factors but its treatment offers "the greatest prospect for lowering health costs and improving quality of life" (Millard, "Nuts and Bolts..." 36).

The desirable treatment for hypertension is disputed by the medical community. Generally, mild hypertension is not treated. Two thirds of hypertensive patients have a diastolic blood pressure below 105 mmHg, which is considered mild, and not treated with medication (Millard, "Nuts and Bolts..." 36). Many physicians do not treat patients with mild hypertension because they do not feel the risk resulting from mild high blood pressure is strong enough to

warrant the use of medication. Many physicians believe that mild hypertension should be controlled through simple behavior modifications, such as reducing sodium intake, increasing physical activity, and losing excess weight, and that only severe hypertension should be controlled through medication (Zaret, Moser, Cohen, 160-162). However, these alternative treatments are often underrated by physicians as a means to control high blood pressure, and therefore, not used to control hypertension.

Many times, when patients are treated medically for hypertension, they are not compliant with their treatment. This nonadherence may be attributed to their misunderstanding of their condition. Theories about noncompliance will be examined in the chapter dealing with motivational factors.

### *High Serum Cholesterol*

Epidemiological studies have shown that high blood cholesterol levels are a strong risk factor for developing cardiovascular disease. Cholesterol, at appropriate levels, is not the "bad guy" it has been made out to be by marketers. Cholesterol is necessary in the body due to its three main functions. Certain glands use cholesterol to produce hormones, such as sex hormones; it helps the liver manufacture bile acids, which are needed to digest fats (Zaret, Moser, Cohen, 38). The most important function of cholesterol is that it is the main component of cell membranes and structures, a "kind of building block for bodily tissues" (Zaret, Moser, Cohen, 38). For those reasons, cholesterol is crucial for the sustenance of life.

The risk for disease comes when there is too much cholesterol in the blood. In the circulatory system, the various forms of cholesterol have very different functions. Since

cholesterol is fatty in nature, it cannot blend with blood, which is water-based (Zaret, Moser, Cohen). Therefore, in order to be transported through the blood stream, cholesterol combines with protein to form *lipoprotein*. These lipoproteins are categorized according to the size and density of the molecule. Though there are several kinds of lipoproteins, two are important in the development of heart disease. *Low-density lipoproteins*, the "bad cholesterol," have a relatively low amount of protein, while *high-density lipoproteins*, or "good cholesterol," contain a relatively high amount of protein.

As the carrier of approximately 65 percent of plasma cholesterol, low-density lipoprotein cholesterol, plays an important role in depositing cholesterol in the arterial walls (Pollock & Wilmore, 18). Conversely, high-density lipoprotein cholesterol, which carries around 20 percent of the plasma cholesterol, is responsible for carrying cholesterol from the arterial wall to the liver where it is metabolized and excreted (Pollock & Wilmore, 18).

When there is an excess of cholesterol present in the body, there is an increased risk for developing cardiovascular disease. *Atherosclerosis*, or the build up of fatty deposits on the arterial walls, develops over a long period of time. When the inner walls of the coronary arteries are damaged by cigarette smoking, hypertension or stress, these damaged areas, or lesions, are susceptible to the build up of fatty deposits creating plaque. Coronary heart disease develops when cholesterol is deposited on the walls of the coronary arteries by the low density lipoproteins. These deposits promote the formation of fatty, toughened blockages, called plaque, which decrease the supply of oxygen to the heart muscle (Zaret, Moser, Cohen, 38). The plaque present in the coronary arteries decreases the diameter of the artery; this creates a section of the artery vulnerable to total obstruction by plaque or a blood clot. The obstruction then stops the

blood flow to the cardiac muscle causing a myocardial infarction.

In terms of measurement, total cholesterol, by itself, is not as important as a predictor of coronary artery disease. High-density lipoprotein and low-density lipoprotein levels are necessary to have a more accurate risk prediction. A low total cholesterol is not necessarily an indication of a desirable ratio of high-density lipoprotein and low-density lipoprotein. High-density lipoprotein levels should ideally be greater than 35 mg/dl (Zaret, Moser, Cohen, 30). Low-density lipoprotein levels above 160 mg/dl are associated with increased risk (Zaret, Moser, Cohen, 30). Generally, the ratio of total cholesterol to high-density lipoprotein is used to predict risk (Millard, "Nuts and Bolts...", 37).

As consumers have become more health conscientious in their eating habits, advertisers have taken advantage of the establishment of cholesterol as a risk factor for heart disease; as a ploy to sell products, advertisers label products as "low in cholesterol" or "cholesterol-free" though the product has never contained cholesterol. Oversimplification about cholesterol has enabled manufacturers to capitalize inappropriately (Millard, "Nuts and Bolts..." 37).

Though reducing intake of saturated fat derived from animal products is necessary to decrease the risk for heart disease, its importance has been overrated. Only 20 percent of the cholesterol comes from exogenous sources, those sources that come from outside the body (Millard, "Nuts and Bolts..." 37). Dietary cholesterol is only found in animal products, or products which contain an animal-source. The remaining 80% of cholesterol is produced in the body. Therefore, only a small portion of the cholesterol found in the body is controllable through the diet. Exercise, as well as medication, can have a positive impact on cholesterol. The role of exercise on cholesterol will be explored in the chapter focusing on the benefits of cardiac

rehabilitation.

### *Smoking*

Of the risk factors, the most deadly is cigarette smoking. Ezra A. Amsterdam, M.D., professor of Internal Medicine at University of California, Davis, School of Medicine, and Director of Coronary Care Unit at U.C., Davis, Medical Center, states that "Nothing is as effective in preventing heart disease as your own decision to stop smoking. If you could do only one of two things--either to continue coming to the doctor and getting all our interventions and medicines or to stop smoking--it would be in your interest to fire us and stop smoking" (Amsterdam, Eliot, and Stampfer, 36). In fact, the Surgeon General reported in 1990 that tobacco use, the leading cause of preventable death, is responsible for over 350,000 deaths a year from heart disease (Zaret, Moser, Cohen, 72, 77).

Smoking by itself forces the heart by increasing the concentration of catecholamines, the stimulatory chemical messengers of the autonomic nervous system, in addition to increasing the amount of carbon monoxide in the blood (Zaret, Moser, Cohen, 73). In response to these increases, blood vessels narrow, which decreases the area through which the blood must flow. With narrowed vessels, the heart must pump harder and faster in order to supply the body with the oxygen carried in the blood. This decrease in vessel diameter causes an increase in blood pressure, which is another risk factor for cardiovascular disease. Bouts of angina are more likely due to the vessel restriction which reduces blood flow to the heart (Zaret, Moser, Cohen, 73).

Smoking has also been shown to affect serum cholesterol. Smokers tend to have a higher level of low-density lipoprotein, which is main cholesterol-carrying component, and triglycerides,

with relatively low levels of high-density lipoprotein (Zaret, Moser, Cohen, 72). This further increases their risk for cardiovascular disease for several reasons. Smoking accelerates arteriosclerosis, or hardening of the arteries, and atherosclerosis (Zaret, Moser, Cohen, 72). These processes are accelerated partially due to the damage done to arterial walls as a result of the increased levels of carbon monoxide in the blood; these roughened, damaged areas are susceptible to the build up of fatty deposits creating lesions on the arterial walls (Zaret, Moser, Cohen, 72). The tendency to accumulate fatty deposits is greatly increased because of the greater amount of low-density lipoprotein carrying cholesterol, and triglycerides, which are common components of the fatty deposits, caused by cigarette smoking. In addition, there are fewer high-density lipoprotein available to help remove the excess cholesterol from the artery walls and transport them to the liver for excretion (Zaret, Moser, Cohen, 37).

Also affected by cigarette smoking are the levels of fibrinogen, a component of blood necessary for clotting. An increase in fibrinogen, which occurs with smoking, amplifies the possibility of blood clots forming and obstructing arteries (Zaret, Moser, Cohen, 72). This leads to an increased risk of a myocardial infarction, or heart attack, due to the already narrowed arteries that result from cholesterol deposits and vasoconstriction caused by smoking. Blood platelets also tend to clump abnormally due to smoking, which further increases the risk of blocking the coronary arteries (Zaret, Moser, Cohen, 73).

Estrogen production is reduced by cigarette smoking. Estrogen production, though not fully understood, has been shown to provide women with a natural protection against premature atherosclerosis (Zaret, Moser, Cohen, 72). Thus cigarette smoking removes a natural defense against cardiovascular disease, along with increasing the risk through the mechanisms mentioned



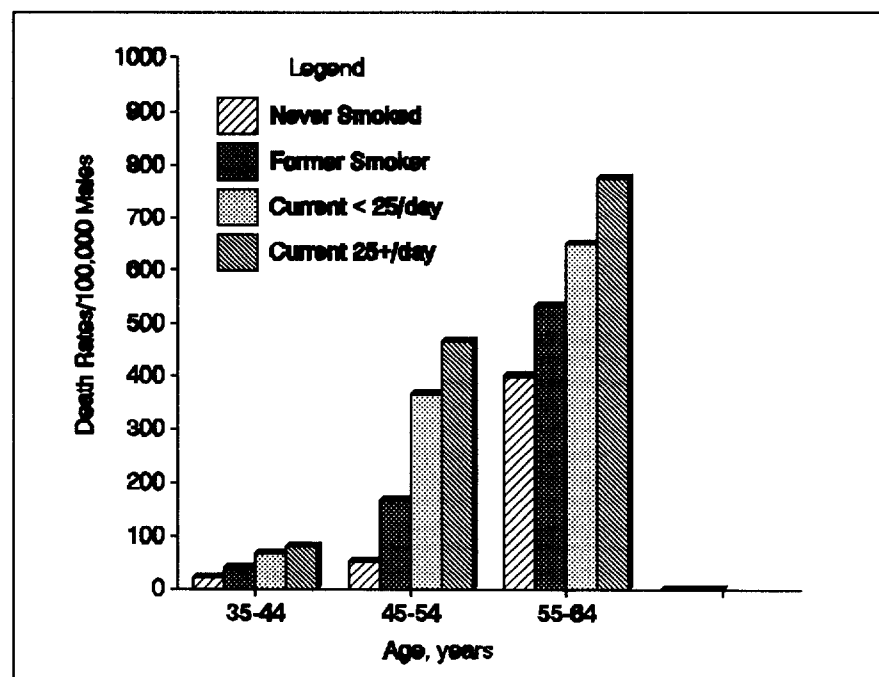
previously.

Smoking, in general, is representative of an individual's overall compliance with healthy behaviors (Comoss, 25). Therefore, since smokers tend not to participate in healthy behaviors, most will have several other risk factors in addition to their tobacco usage. Though tobacco use alone has very damaging effects on the body, cigarette usage in addition to other cardiovascular risk factors presents a much higher risk for heart disease. The results of the longshoremen study of 1977 showed that the population might have lowered their incidence of fatal heart attacks during the 22 year study by 88 percent through simply modifying their risk factors of low-energy output, heavy smoking, and hypertension (Pollock & Wilmore, 29).

Unfortunately, smokers are not the only ones who are at risk for cardiovascular disease. Studies have shown that exposure to cigarette smoke can also increase the risk for heart disease. A study conducted by White and Froeb showed that exposure to smoke in the workplace was

damaging to the nonsmokers (Pollock & Wilmore, 17). Other studies have concluded that passive smoking increases the risk of death and heart disease in nonsmokers (Pollock & Wilmore, 18).

Smoking cessation has shown to reduce the



**Figure 2** Increased risk for coronary artery disease with smoking. (Pollock and Wilmore, 17)

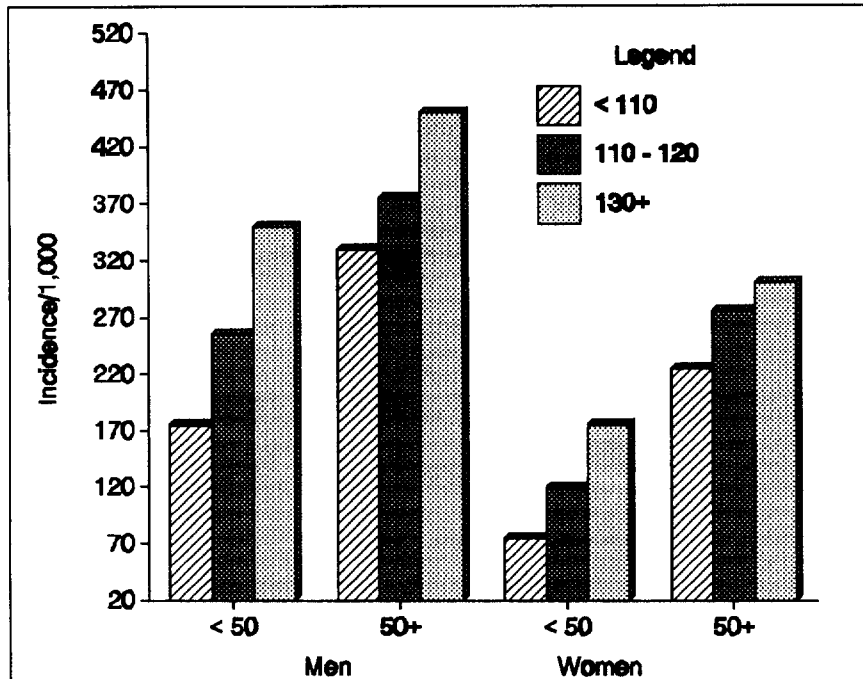
risk of cardiovascular disease. Discontinued smoking can reduce the incidence of death in the former smokers to a level lower than those who continue to smoke (Pollock & Wilmore, 17). Figure 2 on the previous page shows the risk stratification of nonsmokers, former smokers, and current smokers (Pollock & Wilmore, 17). Those who have never smoked or have quit smoking display a significantly lower risk for heart disease.

### *Obesity*

Obesity, which is classified as being above or equal to 30 percent overweight, is another risk factor that contributes to heart disease. The famous Framingham Study was the first to establish the positive relationship between obesity and cardiovascular disease (Leaf, 653). In another study of 100,000 women age 30 to 55, the risk for heart disease was more than three times higher among those who were the most obese (Zaret, Moser, Cohen, 31). The weight problem is a significant one in the United States, as an estimated 34 million Americans are overweight, including 12 million with significant obesity (Leaf, 653). Figure 3, on the following page, shows the increased risk that comes with overweightedness (Pollock & Wilmore, 22).

There are two classifications of obesity according to the weight distribution. *Gynoid-type obesity*, characteristic of women's pear shaped bodies, involves a increased amount of fat cells deposited around the hips and buttocks (Howley, Franks, 116). *Android-type obesity*, or apple shaped obesity, results from hypertrophy of the fat cells in the abdominal area (Howley, Franks, 116). Android-type obesity is independently associated with a higher risk for coronary artery disease, as well as in relationship with other risk factors (Zaret, Moser, Cohen, 31).

The relationship of obesity and cardiovascular disease, though proven to be linked, is not



**Figure 3** Role of being overweight in increasing risk for coronary artery disease. (Pollock and Wilmore, 22)

fully understood. Obesity is associated with hypertension, high blood cholesterol, and diabetes, which are all independent risk factors for cardiovascular disease (Zaret, Moser, Cohen, 30). Weight reduction has not resulted in a reduction in

morbidity and mortality as an independent factor

(Squires, 747). However, with its impact on hypertension, cholesterol and diabetes, obesity should be corrected. Dr. Stampfer claims that "a loss of just 10 or 15 pounds can make quite a difference in terms of diabetes and blood pressure" (Millard, "Nuts and Bolts..." 38).

### *Diabetes Mellitus*

Type II diabetes mellitus has been established as a contributor to the risk for coronary artery disease. Approximately 7 million Americans have been diagnosed with diabetes mellitus, with 650,000 new diagnoses every year; of these 7 million diabetics, nearly 90 percent are noninsulin-dependent, or Type II, diabetics ("Healthy People 2000", 73). Type II diabetes, generally beginning after age 40 or 50, is characterized by a decrease in cellular sensitivity to

insulin ("Guidelines for Exercise Testing..." 168).

Though its role is not fully understood, diabetes doubles the risk for cardiovascular disease by accelerating atherosclerosis and contributing to hypertension (Pollock & Wilmore, 22).

This appears to be caused by the slightly elevated levels of insulin in the blood, in addition to the tendency for Type II diabetics to be obese (Zaret, Moser, Cohen, 31).

### *Stress*

Stress has been linked to cardiovascular disease due to its effect on atherosclerosis. Stress, defined as the "state in which individuals are faced with the need to make difficult or undesirable changes in order to adapt to events and situations in their lives," encompasses both physical and psychological factors, as well as mental, emotional and behavioral responses (Zaret, Moser, Cohen, 95).

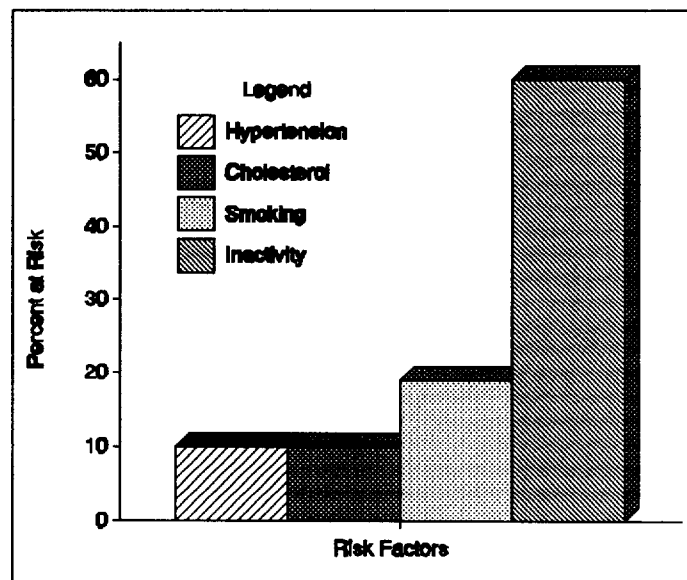
When under stress, the body undergoes the "fight-or-flight" response which demands placed on it. During this response, the sympathetic nervous system is activated and the pituitary gland releases hormones which stimulate the release of adrenaline-like substances and cortisol (Zaret, Moser, Cohen, 97). As a result, the heart rate and blood pressure increase, while blood flow to the brain and large muscles increases (Zaret, Moser, Cohen, 97). The fat stored in tissues is mobilized and transformed into fatty acids to provide the needed energy for the response (Zaret, Moser, Cohen, 97).

The increased risk for disease comes when the resources made available in the fight-or-flight response are not used. With the high heart rate and blood pressure comes increased pressure on the arterial walls. The turbulence in the blood resulting from the stress response

hormones damage the lining of the arteries (Zaret, Moser, Cohen, 97). Platelets rush to the damaged areas to repair these areas, creating a thickened portion of the artery. This, in addition to the unused low-density lipoprotein remaining from the fight-or-flight response, leave the artery vulnerable for blockage (Zaret, Moser, Cohen, 97).

### *Physical Inactivity*

Physical inactivity has come to the forefront as one of the most important risk factors in the development of coronary artery disease. According to the research obtained to complete the health objectives established for Americans in "Healthy People 2000," less than 10 percent of Americans exercise 3 or more times a week at levels necessary to improve cardiorespiratory fitness ("Healthy People 2000" 55). This is the most prevalent risk factor in the United States, as demonstrated in Figure 4.



**Figure 4** U.S. population at risk for physical inactivity compared with the three major risk factors. (Pollock and Wilmore, 31)

The importance of physical inactivity lies within its interaction with the other risk factors, including hypertension, cholesterol and triglyceride levels, obesity, diabetes, stress, and potentially cigarette smoking. All of these factors can be affected by physical inactivity.

It has been shown that the benefits of increasing physical activities to moderate levels

outweigh the risks of inactivity. Therefore, these benefits will be the focus of the following section.

## **Benefits of Cardiac Rehabilitation**

Cardiac rehabilitation today is much different than when it began in the 1930s. For the first 20 years of existence, cardiac rehabilitation following a heart attack involved 6 weeks of strict bed rest, which resulted in considerable reduction in cardiovascular fitness (Squires, et al., 732). In 1951, "armchair treatment," a technique promoted by Levine and Lown which included sitting upright in an armchair for increasingly longer periods of time, greatly reduced the morbidity and mortality of heart attack patients (Squires, et al., 732).

The formal introduction of cardiac rehabilitation came in the 1960s with the introduction of electrocardiographic monitoring (AACVPR, 1). By introducing aerobic training, rehabilitation clinics found that heart attack patients could recover much more quickly and thoroughly than expected (Squires, et al., 732). The 1970s brought about the introduction of risk factor concepts and guidelines for cardiac exercise programs (Squires, et al., 732).

Cardiac rehabilitation today involves much more than just the aerobic activity; education about heart disease and its risk factors, as well as coping skills, have become an integral part of rehabilitation.

Since the early days of cardiac rehabilitation, much more is understood about its impact on patients with documented cardiovascular disease, though it is still not fully understood. With the increased knowledge about the benefits of rehabilitation came a new purpose for cardiac rehabilitation. The emphasis of cardiac rehabilitation has evolved with the increased knowledge

about the benefits gained from activity. The goal of rehabilitation programs now is to improve the quality of life in patients, rather than to reduce mortality rates (Logan, 379).

The controversy over the impact of rehabilitation on heart disease has kept many physicians skeptical about the benefits a person can gain from aerobic activity and risk factor modification. There is, however, promising results from studies supporting the use of cardiac rehabilitation in the treatment of cardiac patients. The lifestyle changes that result from rehabilitation can not guarantee a longer life; these changes can however enhance the quality of life, including both physical and psychological. The physical improvements resulting from regular physical activity, to be discussed in the following pages, greatly outweigh the relatively low risk of participating in such activity.

### *Exercise Guidelines for Cardiovascular Benefit*

A common misconception about exercise is that it must be vigorous in order to reduce risk for cardiovascular disease. Studies have shown that moderate activity will produce the benefits needed to reduce risk factors and increase fitness. According to Dr. Meir Stampfer, associate professor of epidemiology at Harvard School of Public Health, assistant professor in the Department of Medicine at Harvard Medical School, and physician at Brigham and Women's Hospital in Boston, "You don't need to run a marathon. You just need to push yourself away from the table and walk around the block a few times" (Millard, "Nuts and Bolts..." 38). Exercise does not have to be a hard, strenuous process, but can involve simple, enjoyable modifications in lifestyle.

The American College of Sportsmedicine (A.C.S.M.) has set guidelines to define the

program needed to achieve fitness and reduce risk. According to the A.C.S.M., exercise, in order to produce benefits, must consist of aerobic activities performed 3 to 5 times a week lasting 15 to 60 minutes at intensities ranging from 55 to 90% of the maximal heart rate; lower intensity levels within the range listed above are recommended for sedentary or unfit populations to reduce risk for musculoskeletal injuries ("Guidelines for Exercise Testing...", 96). Aerobic exercises, which refer to those that use

oxygen, are rhythmic activities that utilize large muscle groups and can be maintained for an extended period of time (Zaret, Moser, Cohen, 87). They include, but are not limited to, walking, jogging, swimming, cycling, rowing, and aerobic dancing. In order to improve cardiovascular fitness,

Karvonen Formula		
$\text{Target Heart Rate} = 220 - \text{age} - \text{resting heart rate} * \text{intensity} + \text{resting heart rate}$		
Example:		
Age = 20	Resting heart rate = 60	Intensity = 60%
$220 - 20 (\text{age}) = 200 \quad \text{estimated maximal heart rate}$		
$200 - 60 (\text{resting heart rate}) = 140 \quad \text{heart rate reserve}$		
$140 * .60 (\text{intensity as a decimal}) + 60 (\text{resting heart rate}) = 144 \quad \text{target heart rate}$		

**Figure 5** Predicting target heart rate using the Karvonen formula.

these activities should be performed at least 3 times a week for 20-30 minutes.

Training intensity, or the 55-90% of maximal heart rate, is based on the heart rate achieved through exercise. The *target heart rate* is a percentage of the maximal heart rate, the maximum number of times the heart will beat in one minute.

If not measured through a maximal graded exercise test, the maximal heart rate for healthy individuals can be calculated using the Karvonen formula. This formula estimates the *maximal heart rate* by subtracting age from the constant variable, 220. The resting heart rate



is then subtracted from the maximal heart rate to determine the *heart rate reserve*. The heart rate reserve is multiplied by the desired intensity level, generally between 60 and 80 percent. Finally, the resting heart rate is added to the product of the heart rate reserve and intensity, to determine the target heart rate. Figure 5 on the previous page demonstrates the Karvonen Formula, using the age predicted maximal heart rate. During moderate exercise at 40 to 60 percent of the maximum, the heart rate should reach and be sustained at the target heart rate.

### *Benefits of Aerobic Exercise*

After exposure to a regular, moderate exercise for an extended period of time, the body begins to make peripheral, and possibly central, adaptations increasing its efficiency to cope with the added demands placed on it. This adaptation, referred to as the *training effect*, is indicated by the 10 to 30 percent increase in maximal oxygen consumption ( $\text{VO}_2 \text{ max}$ ) in many cardiac patients (Squires, et al., 742).

Through the peripheral adaptations that come with regular aerobic training, there is an increase of blood flow to the exercising muscles with a decrease in flow to the nonexercising muscles (Oldridge, 61). The muscles become more efficient in extracting the oxygen present within the blood, enabling the sympathetic nervous system to produce less norepinephrine (Round Table, 137). The effect of these adaptations is that the muscles are more able to extricate oxygen from the blood, while the heart beats fewer times. Not only does the heart beat fewer times while continuing to supply the muscles with sufficient oxygen, but also lungs inhale fewer times to provide the necessary oxygen (Zaret, Moser, Cohen, 87).

These peripheral adaptations, however, will only occur in the muscle groups being trained.

The reason for this is that exercise disrupts the homeostasis of the cells, resulting in a higher heart rate and cardiac output (Round Table, 138). Trained muscles have adapted to the exercise load by developing more muscle mitochondria; the result is less of a disruption in the cellular homeostasis, including a smaller decrease in high-energy phosphates used to fuel exercise, and smaller increase in lactate, a toxic by-product of fatty acid metabolism (Round Table, 138).

In addition to the increased efficiency of the skeletal muscles, the heart also becomes more efficient. As the heart can beat fewer times due to improved extraction of oxygen by the muscles, the heart becomes more able to completely empty during each contraction (Round Table, 139). This means that the heart pumps more blood out to the body with fewer beats, making more oxygen available for the muscles. Dr. John Holloszy, a professor at the Washington University School of Medicine, found that patients after training attained a lower end systolic blood pressure, along with a higher end diastolic blood pressure, indicating the improved contractions by the heart (Round Table, 139).

Once the training effect has been attained, the body is able to work at higher demands with less effort than if it were untrained. As a result, everyday tasks can be performed with less fatigue, shortness of breath, and perceived exertion, while the productivity and quality of life may be considerably enhanced (Squires, et al, 742). For elderly patients, improved quality of life enables them to live independently longer, while lowering the costs of nurse or custodial care (Oldridge, 62). Singapore General Hospital Cardiac Rehabilitation reported fewer complaints of common illnesses, such as the flu and headaches, in addition to better physical well-being (Sabapathy, 237).

In individuals with mild hypertension, exercise alone may lower blood pressure just as

effectively as exercise in combination with an antihypertensive drug (Massie, 90). Endurance training can result in reductions in both systolic and diastolic blood pressure of about 10 mmHg (Pollock & Wilmore, 34). According to Dr. Michael Pollock, a professor in the at the University of Florida, and Dr. Jack Wilmore, professor at the University of Texas, the mechanisms by which exercise lowers blood pressure are not fully understood, but probably include any of the following: reductions in resting sympathetic tone; decreases in baroreceptor sensitivity; changes in myogenic structures, tone, or relationships; and decreases in resting cardiac output (Pollock and Wilmore, 34).

Increase in activity, in addition to proper eating habits, is the most desirable way to control weight. Generally, overweight people consume more calories than they burn, causing the body to store the extra calories as fat. Not only does exercise increase the amount of calories burned, but it also promotes the loss of fat rather than the leaner and desired muscle mass (Zaret, Moser, Cohen, 87). According to B.F. Skinner and his colleagues, an increase in 400 to 500 calories above normal sedentary levels were associated with a significantly lower risk in heart disease (Pollock & Wilmore, 27). The increase in caloric expenditure, along with a healthier diet, has been proven to be the most effective way to regulate and maintain weight.

Cholesterol and triglyceride levels can also be affected by exercise. The specific role of exercise is not clear, due to the other benefits of exercise. Exercise individually appears to increase high-density lipoprotein and triglyceride metabolism (Round Table 141). Exercise in combination with weight loss has been shown to reduce the level of low-density lipoprotein with a dramatic increase in the level of high-density lipoprotein (Round Table, 140). Healthy improvements in dietary selections is partially responsible for the improvement in cholesterol

values. These are positive changes for reducing cardiovascular risk, as there is less low-density lipoprotein to be deposited on the arterial walls, along with more high-density lipoprotein to carry excess low-density lipoprotein away from arterial walls.

Exercise also provides better control over diabetes mellitus for a couple of reasons. First, exercise can help manage obesity, a factor that generally accompanies diabetes. Also, exercise increases the cellular sensitivity to insulin, resulting in more control over the blood sugar level (Zaret, Moser, Cohen, 93). The increased sensitivity to insulin can improve hypertension, as is a common result of diabetes.

Exercise is a necessary outlet for stress. Exercise, following a stressful situation, expends the resources mobilized for the fight-or flight response. The stress hormones and fatty acids circulating in the blood are metabolized during exercise, thus limiting the impact on atherosclerosis.

For many people, exercise is a tool used to abstain from smoking. Though there is no direct link between exercise and smoking cessation, the psychological impacts of exercising often result in greater willpower to quit smoking. Those who begin to exercise soon realize that smoking is not compatible with their reasons for exercising; many are able to quit smoking due to their new healthier lifestyle (Pollock & Wilmore, 34). Exercise is also commonly used as a replacement behavior for smoking in cessation programs (Pollock & Wilmore, 34). Exercise, as a stress reliever, can be used to substitute smoking in stressful situations.

Patients who frequently experience angina can find relief in exercise. Angina, or chest pain, occurs at a threshold in which the heart is no longer being supplied with the oxygen it needs. Reduction in angina, according to Dr. Henry Miller, Jr., director of the cardiology

department and medical director of cardiac rehabilitation at Wake Forest University Medical Center, results from the decrease in the oxygen demanded by the cardiac muscle, rather than from an increase in supply (Round Table, 139). Angina is controlled by the improvement in the efficiency of the body in extracting oxygen allowing the heart to function below the threshold.

All of these benefits which come from exercise are complimented by the improvement in self-esteem felt by most exercisers. As people see the reduction in weight, ability perform everyday tasks with less fatigue, and feel the other benefits of healthier living, they begin to feel better about themselves. The result is an improvement in health and attitude about life.

In addition to all of the benefits mentioned previously, cardiac rehabilitation enables patients to return to work sooner, with improved performance. Recent studies have shown a significant cost-benefit to rehabilitation. In a study conducted by Picard and Schwartz patients in rehabilitation returned to work an average of 24 days earlier with 32% shorter convalescence, resulting in a cost-benefiting an additional \$2,102 salary earned per patient in the six months following the heart attack (Oldridge, 64). The combination of increased income of each patient and the lower medical costs for each patient accounted for a potential cost-benefit of over \$800 million per year (Oldridge, 64).

Cardiac rehabilitation does not cure patients of their coronary heart disease. It can only provide a means to live a fuller, healthier life, with the possibility of lower morbidity and mortality. The benefits gained from rehabilitation, however, depend on the willingness of the patient to comply with the behavior changes necessary to improve the risk for heart disease. With understanding of motivation for behavior modification, rehabilitation staff can encourage patients to be compliant.

## **Motivation: What Causes Patients to be Compliant?**

Sources of motivation to participate in an exercise program is a key issue for cardiac rehabilitation programs. In any given exercise program, including cardiac rehabilitation, the dropout rate averages 50 percent (Comoss, 24). With such high dropout statistics, it is important for rehabilitation programs to recognize the source of patient motivation during different stages of their recovery process.

Recovery from a coronary event, as well as prevention of such events, through cardiac rehabilitation must be maintained for years, ideally a lifetime, in order provide the cardiovascular benefits necessary to reduce risk of future events. As time passes there is an increase in noncompliance because of the difficulty in making permanent behavior change. During this long term maintenance, sources of motivation for those who continue in the program will change. Rehabilitation staff can improve compliance by becoming aware of issues affecting compliance. By identifying the predictors of noncompliance as well as incentives for adherence to the program, the rehabilitation staff can develop intervention techniques that reinforce the patient's source of motivation.

### *Common Characteristics in Noncompliers*

Although each patient will respond differently to rehabilitation, noncompliers often share certain attributes. Patricia McCall Comoss, R.N., C.C.R.N., Nurse Consultant for Cardiac Rehabilitation in Harrisburg, Pennsylvania, has grouped the factors affecting noncompliance can be placed into two categories: *personal characteristics* and *program features* (Comoss, 25).

Personal characteristics are internal factors that tend to lead to noncompliance. These characteristics, which include physical and psychosocial components, are listed in Table 1 (Comoss, 25). Program features include aspects of rehabilitation that prevent compliance, such as inconvenient exercise time or location.

According to Comoss, smoking has the highest correlation with noncompliance due to the patients' general lack of compliance with healthy habits (Comoss, 25). Many times smokers do not comply with their risk factor modification because they tend to feel less concerned for their health, as indicated by their unhealthy smoking habit.

Blue-collar workers tend to lack the understanding of their disease and to use health services less often than do white collar workers (Comoss, 25). This finding is supported in a study conducted at the 92nd Street

Y.M.-Y.W.C.A. in New York City, which compared those who joined an

exercise program to those who did not after participating in a Coronary Heart Disease risk assessment. The results showed that joiners generally had a higher level of education with 41 percent of the joiners having earned a graduate level degree, compared to 19

percent in the non-joiners (Mirotznik, Speedling, Stein, Bronz, 14).

**Table I** Personal characteristics contributing to noncompliance in cardiac rehabilitation (Comoss, 25)

Physical	Psychosocial
Smoking	Lack of spouse support
Blue-collar occupation	Lack of self-motivation
Inactive leisure	Mood disturbance
Overweight	Introverted personality
Angina	External focus of control
Low ejection fraction	Extreme Type A personality

Many times patients are not compliant with their treatment, whether medication or

behavior modification, because they do not understand their disease, or how the treatment will help them. The failure of patients to understand disease can be caused by several factors: the patients may be less educated or incapable of understanding their disease; the physician may not have properly educated the patients about their disease; or cultural conceptions about a disease mislead patients to believe falsely. In a study dealing with compliance in the treatment of hypertension among Afro-Americans, Dr. S. Heurtin-Roberts of the Department of Epidemiology and Biostatistics at the University of California, found that compliance correlated with beliefs about high blood pressure. These belief systems, which include the *biomedical model*, the "*high blood*" theory, and the "*high-pertension*" theory, are described below (Heurtin-Roberts, 2864).

The biomedical model is the theory accepted by the medical community. In the biomedical model, blood pressure is the measurement of the pressure within the arteries when the heart contracts, called *systole*, and when it contracts, called *diastole*.

"High blood" was defined as a physical disease of the blood and heart; the blood becomes too "hot," or "rich," or thick," causing the level of the blood to slowly rise in the body and remain high for prolonged periods of time (Heurtin-Roberts, 2864). Patients believed high blood to be caused by heredity, poor diet, and "heat", and can be treated through the diet or various folk remedies, such as drinking lemon juice, vinegar or garlic water (Heurtin-Roberts, 2864).

According to Heurtin-Roberts, "high-pertension" was considered to be a volatile and episodic disease "of the nerves" caused by stress, worry and an anxious personality (Heurtin-Roberts, 2864). During periods of emotional excitement, the blood "shoots up" quickly toward the head, and then "falls back" or "drops back" rapidly (Heurtin-Roberts, 2864). This disease



was thought to be managed through controlling emotions and the social environment (Heurtin-Roberts, 2864).

This study found that the patients who believed in one or both of the folk illnesses, the "high blood" or "high-pertension" illnesses, were less likely to comply with their medication than were the patients who believed in the biomedical model. Those who believed exclusively in the "high-pertension" theory 3.3 times more likely to be uncompliant in taking their medication; they believed their illness was controllable simply through controlling stress and emotional excitement rather than through medication (Heurtin-Roberts, 2864). Lack of understanding the disease caused noncompliance in these individuals.

Those with a sedentary lifestyle tend to be less compliant with risk reduction. For inactive people, adopting a new routine of daily activity to replace their previously sedentary routines is difficult (Comoss, 25). A study conducted in the Johannesburg Cardiac Rehabilitation Centre found that dropouts spent significantly less time exercising in the first 6 months and exercised at lower intensities (Digenio, Padayachee, Groeneveld, 126). After a coronary event, people learn coping skills to deal with their disease.

The length of time between the coronary event and the contact made by the rehabilitation staff also predicts participation in the program. After the first month, there is a much lower chance of recruiting patients to participate in rehabilitation because people have already developed adjustment patterns (Miller, et al., 335).

In the 92nd Street Y.M.-Y.W.C.A. study, younger individuals were less likely to join an exercise program; people who joined the fitness program were an average of 4 years older and more likely to be retired or employed part time, indicating a higher awareness of mortality

(Mirotznik, Speedling, Stein, Bronz, 14). Younger individuals do not feel as susceptible to illness as their older counterparts, leading to a lower motivation to prevent the incidence of such illnesses. In addition, the older age groups are either retired or semi-retired and can more easily attend the program, while younger people must find time around the work schedule to attend rehabilitation (Digenio, Padayachee, Groeneveld, 126).

Overweightness can cause nonadherence for several reasons. Overweight patients are more inclined to develop musculoskeletal problems due to the excess weight that they are carrying during exercise. Overweight patients also get discouraged because they can't lose their extra weight as easily or quickly as is desired. A 1982 study of patient success in risk factor modification found that individuals were successful in losing weight only 33 percent of the time (Pynn, 82). The failure of exercise to produce immediate results causes many to drop-out of the program.

Patients experiencing angina frequently dropout of their exercise program because of the discomfort they feel during exercise. Patients with low ejection fractions, which is a measurement of how well the heart pumps blood out to the body, are also inclined to discontinue their rehabilitation (Comoss, 26). In Y.M.-Y.W.C.A. study, maximal oxygen uptake ( $VO_2$ ), a value directly correlating with the ejection fraction, predicted the compliance in a program. Though patients with a lower  $VO_2$  were more likely to enroll in an exercise program, they were less likely to be compliant than those with a higher  $VO_2$  (Mirotznik, Speedling, Stein, Bronz, 15).

Lack of spouse support is the psychosocial factor most associated with noncompliance, impacting compliance more strongly than all of the other contributing factors. (Comoss, 26).

Spousal support includes not only encouragement for the cardiac patient, but also understanding

the risk factors associated with the disease. The need for this understanding is especially important for compliance with diet, smoking, activity, and medication (Goble, Worcester, 99). Of the patients surveyed in the Austin Hospital Cardiac Rehabilitation Trial, 85 percent of the patients who had abandoned smoking and whose spouses continued to smoke had resumed smoking 12 months later (Goble, Worcester, 98). The need for spousal support and encouragement is vital, especially in the initial period of recovery while the memory of the cardiac event is still fresh.

Also included as possible psychosocial indicators of nonadherence are lack of self-motivation, mood disturbances, introverted personality, an external locus of control, in which the patients feel that they have no control over their disease but control, rather, comes from an outside source, and extreme Type A personality (Comoss, 26). Blumenthal, Williams, Wallace, Williams, and Needles concluded in their 1982 study that those who dropped out of the program were experiencing more depression and anxiety upon entering the program, were socially introverted, and had low ego strengths (Charlton, 180). Some studies, however, showed no correlation between compliance and self-esteem, ego-strength, or locus of control (Radtke, 182). This discrepancy may be due to counseling for self-esteem and ego-strength available in some programs while not in others.

Program features can also affect compliance. Convenience of the exercise program can reflect the amount of compliance in a program, as there is a direct correlation between the number of obstacles to participation and the level of compliance (Mirotznik, Speedling, Stein, Bronz, 17). A study of Becker's Health Belief Model conducted by Holm, Christman, and Ashley in 1985 found that the primary reasons for missing exercise sessions were illness, lack

of money, lack of transportation, work, lack of confidence in effectiveness of the program, and owning exercise equipment (Charlton, 180). Oldridge found that job related reasons accounted for 34% of the dropouts from the Ontario Exercise-Heart Collaborative Study (Digenio, Padayachee, Groeneveld, 125). Several of the factors listed above can be affected by the program features.

### *Factors Contributing to Compliance*

Developing a rehabilitation program, or any exercise program, is a difficult process. Many factors must be considered in determining the structure of the program. Included in these considerations must be the motives leading individuals to begin an exercise program. The uniqueness of each person makes the prediction of motives impossible, though the motives generally involve a common theme: Health. Whether to feel better, to lose weight, to improve physical fitness or mental working capacity, or to reduce the risk of a heart attack, individuals begin an exercise regimen out of a concern for their health, be it physical or mental.

The extent to which one is concerned about his or her health may predict how motivated that person is to participate in activity. Kasl and Cobb, Rosenstock, and Becker have developed a model explaining the reasons people why participate in preventive behaviors. According to this model, a person will be involved in a particular preventive health behavior to the extent that "(a) he perceives himself as being susceptible to a particular condition, (b) he perceives the condition as serious, (c) he perceives the benefits of that health action, and (d) he perceives few barriers to taking that action" (Mirotznik, Speedling, Stein, Bronz, 17).

As a person feels more vulnerable for a certain serious condition which can be lessened

or prevented by healthy action with very few obstacles, the person will participate in the healthy behavior. These health beliefs, though good determinants for participation in a program, do not predict adherence. Several studies, including the 92nd Street Y.M.-Y.W.C.A. study, found no significant differences in health beliefs among compliers and noncompliers (Mirotznik, Speedling, Stein, Bronz, 17).

As mentioned previously, characteristics of the rehabilitation program can be arranged to improve the convenience of the program. Scheduling the rehabilitation hours to extend beyond common working hours can improve the number of participants in the program (Digenio, Padayachee, Groeneveld, 125). Class hours can also be planned around the local transportation network, such as the bus schedule, so patients without transportation may conveniently come to rehabilitation. Inconvenient exercise times and lack of transportation are definite barriers to exercise programs which can be corrected to retain more patients in the program.

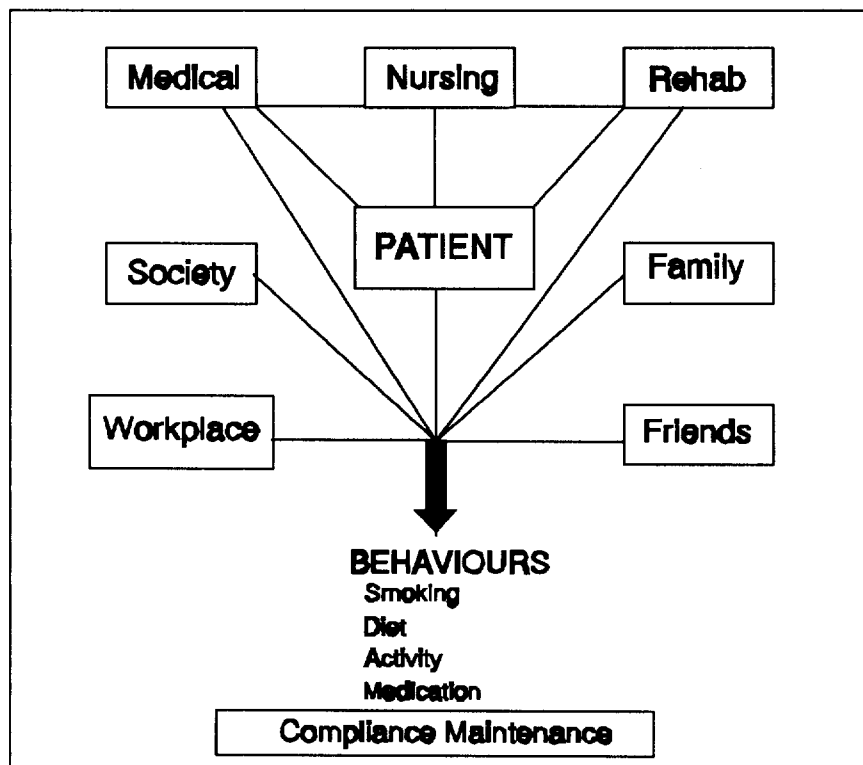
For cardiac patients, the feeling of vulnerability to heart disease is realized with the first recognized symptom. However, the motivation which comes from the desire to prevent further development of the disease lessens over time (Radtke, 186). The motivation must then come from other sources. Figure 6 on the previous page shows the various influences upon compliance (Goble, Worcester, 98).

A 1988 study conducted by Julie Derenowski, R.N., M.S., then a doctoral student at the University of Arizona, evaluated the relationship of social support systems, health locus of control, health value orientation, and wellness motivation in cardiac rehabilitation (Derenowski, 143). During the study, Derenowski tracked over the three stages of cardiac rehabilitation motivation factors contributing to compliance in patients with a myocardial infarction history.

In all phases of cardiac rehabilitation, patients showed a need for the support from significant others, with the greatest need in phase I initially following the heart attack (Derenowski, 149). This is also a critical time for physicians to be involved in the recovery process. Initially following a coronary event, patients often feel dependent on their physician,

creating a desire to please the physician (Comoss, 26). Physicians can thus influence patient compliance initially until the patient gains more confidence and independence.

While the need for the spousal support continues throughout the rehabilitation process, the patient gradually becomes



**Figure 6** Factors affecting patient compliance and maintenance of behaviour change. (Pos = positive; Neg = negative; Rehab = rehabilitation) (Goble and Worcester, 98)

more and more independent. After phase I patients place value on meeting the goals of their family members, they begin to feel more in control of their health and the consequences of their behavior (Derenowski, 150). It becomes crucial for the rehabilitation staff to reinforce the positive changes the patient has made towards wellness and risk reduction (Derenowski, 149).

As patients need to be in control and self-disciplined, they have a greater motivation to meet their exercise and risk reduction goals (Derenowski, 149). With increased action to enhance wellness and reduce risk came decreased belief in chance outcomes in health (Derenowski, 150). The comraderie and support from other patients is important during phase II, as patients recognize the need for help outside of their family (Derenowski, 150). Group activity at this point becomes vital in compliance. Massie and Shephard found a higher compliance in patients who participated in group activity than in those who exercised individually (Digenio, Padayachee, Groeneveld, 125).

The short-term goals turn into long-term goals as the Phase II patients realize the importance of support from others in their endeavor to further reduce risk and maintain wellness (Derenowski, 150). As Phase II patients become more appreciative of support from their significant others, they participate in activities which will develop their whole person (Derenowski, 150). Both Phase II and II patients become more motivated when they receive praise from the rehabilitation staff for their accomplishments, such as weight loss or increased exercise capacity (Derenowski, 149). The drive to continue in wellness behaviors increases when phase II and III patients become more confident in the encouragement and assistance they will receive from their health care providers (Derenowski, 149).

Phase III patients who appreciate the increased amount of help from others held higher value for the wellness behaviors developing all of their attributes, as well as activity resulting in recognition from staff members (Derenowski, 150). Phase III patients with higher levels of support from significant others demonstrated a higher value of self-discipline in making life change and wellness behaviors (Derenowski, 150).

Recognizing these tendencies in the phases of cardiac rehabilitation, rehabilitation staff can develop different motivation techniques to improve compliance for patients at each phase of rehabilitation, while distinguishing the individual differences in the patients. Spousal involvement in rehabilitation has proven to be instrumental in improving compliance, especially for those initially following a coronary event. Unmarried individuals have mortality rates nearly two times higher than their married equivalents (Derenowski, 144). Though spousal involvement is crucial, patients need to become more independent as they progress through the phases to gain a feeling of self-discipline and control over their health. Group involvement should establish a social support network without interfering with the individuals' needs or goals. During the early stage of rehabilitation, encouragement should focus on the progress the patient has made towards his or her goals; the emphasis in the latter phases should be on recognizing the accomplishments in meeting the goals.

### *Conclusion*

Cardiac rehabilitation, according to the evidence on the previous pages, is a worthwhile experience for patients following diagnosis of coronary artery disease. Many physicians agree that regular aerobic training improves the patient's functional capacity and promotes positive risk factor modification with possible improvement in the supply of oxygen to the heart (Round Table, 153). There also tends to be a improvement in morbidity and mortality after endurance training (Round Table, 153).

Physical activity for many has been an effective control over the risk factors that increase the chance of cardiovascular disease. Hypertension, cholesterol levels, diabetes, stress, and



weight can all be managed through exercise. However, due to the unpredictability of cardiovascular disease, there are individuals who do not gain the benefits from cardiac rehabilitation. These exceptions cause skepticism of the value of rehabilitation. Though there is no conclusive evidence to support the benefits of cardiac rehabilitation, the potential physical and psychological improvements gained from exercise with the relatively low risk for injury can lead to a more rapid recovery from coronary events (Todd, Worsornu, Stewart, 256). In a 1986 study performed by Van Camp, 51,303 cardiac patients were studied to determine the complications resulting during outpatient cardiac rehabilitation (Oldridge, 61). There were only 3 fatalities in the 2,351,916 patient-hours of exercise, with less than 30 nonfatal cardiac events (Oldridge, 61). The low incidence of cardiac events shows the safety of the program resulting from electrocardiographic monitoring by the rehabilitation staff.

Rehabilitation staff can improve the benefits gained from the program by incorporating techniques to keep patients compliant in the risk factor modification. Of the motivation techniques, the most effective methods convenience of the program, as well as inclusion of spouses in the rehabilitation process and recognizing the improvements in their fitness.

The value gained from cardiac rehabilitation goes beyond the improvement in overall health of the patients. Rehabilitation programs provide the patient with education about their disease, as well as providing an atmosphere in which the patients can regain control of their lives (Todd, Worsornu, Stewart, 256). Patients who have learned to manage their lives become more able to handle their return to work, as well as the everyday stressors of their lives.

Does cardiac rehabilitation add years to life or life to years? There is no answer that will hold as a universal truth. The lives of many people will be lengthened by cardiac rehabilitation,

while others will have an enhanced quality of life resulting from a higher fitness level. However, there is no guarantee that a person in a rehabilitation program will experience either or both of these benefits. But the potential for improved length or quality of life greatly outweighs the risk for further myocardial injury. These results are a priceless result of cardiac rehabilitation.

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